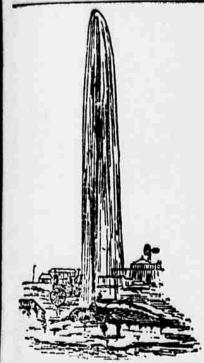
WESTERN IRRIGATION.

SERAT HAMELESS RIVERS THAT MAKE DESERTS BLOOM.

de of Artesian Wette Toppin hem in the West-The Part which septerranean Waters Play in the Vast rigation Problem-A Bountiful Supply aderlies Most of the Desert Wastes-The Idne of Aridity Moving Westward and the Climate Changing-The Spouting Wells in Dakota and California-Statiodes in This and Other Countries,

SECOND ARTICLE,

re are in the United States greater rivers than the Mississippi, stroams of vaster volume use the mighty Missouri. They rise in the mountain ranges, and they are fed not only by the ereams from the everlasting hills, but by builons from other well-known rivers. courses are marked on all the mapa hese vast, newly discovered streams are not



FOUR-INCH STEPAM, 61 PERT RIGH, AT WOOM SOCKET, S. D.

pavigable, they are sluggish but steady in curpert, an their path ano man has yet accuratemarked. They are, indeed, invisible, Only the exploring drill of the wall-boring machine has located them and the careful investigation of expect engineers has yielded an approximate idea of their mighty volume. They unlerice the desert plans of the far West.

enfined in their underground channels by an impervious covering of earth.

Less than one-sixth of the precipitation of the Vississippi valley finds its way to the Gulf gh the channel of the Father of Waters. the Macouri gives at its outlet but 15 per cent, of the precipitation which falls within its drainage basin. The Ohio, on the other hand, delivers to the Mississippi 34 per cent, of the gaver which falls within its valley, and that is the average of most rivers. At one point in the connucl of the Missouri, where the water five over porous sandstone, two-thirds of the y'ver in volume absolutely disappears. In ther words, the river is three times larger shore the point where the thirsty rocks form the ted of the stream than it is below it. On both sides of the Rocky Mountains and the Sierras bundreds of streams, many of them lagerivers are lost in the plains at the foothills or a few score miles beyond. These streams of scormous aggregate volume do and dry up. They disappear in the sandy, spraggearth, and flow on and en in undiminished strength to an unknown outlet to the sea. The Humboldt, the largest river in Nersia, is one of many streams which flows alternately above and below the surface in its course through the desert.

MINING FOR WATER.

The p oblem in many parts of the arid region of the We t is how to recover and make availa-ble the buried treasures of water, without which the land would be uninhabitable. It is ments of Algiers, Oran, and Constantine

of the seepage and fill the reservoir thus formed as completely as possible. The quantity of water and the steadiness of its percolation seem to meet the most sanguine hopes of those who have interested themselves

hopes of those who have interested themselves in this experiment.

THE HISTORY OF ARTESIAN WELLS.

In very few localities is the underground supply so near the surface, and rarely does the topography of the country permit of such tapping of the stream. Artesian wells are the only general resort now available, and thousands of them have been bored during the last fifteen or twenty years. The modern methods of boring for artesian water did not come into existence until the beginning of the present century. The French Society for the Encouragement of Agriculture, in 1818, was the first mover in that direction, and since then the improvement has been most rapid. The Chinese still pursue the ancient method of percuasion in the boring of artesian wells, and they have followed it for more than 3,000 years, The utilization of underground water is a leading

have followed it for more than \$,000 years. The utilization of underground water is a leading fact in the history of Oriental regions, and its importance can be realized by an flustration from one country alone: The plateau, or high table-land region, which forms the greater portion of the peningula of Arabia, is without a single perennial stream or body of surface water. A population of 12,000,000 resides therein: large quantities of wheat durra, baries, millet, beans, and tropical fruits are grown on this high, apparently dry, sterile plateau. Ninety per cent, of the dry, sterile plateau. Ninety per cent, of the water supply, which produces the present fertility. Is drawn from below the surface by means of old bored wells and deep wells or tanks that are dug into the surface of the soil.

MILLIONS OF AGRES RECLAIMED IN INDIA. In British India the system of irrigation by wells is carried on most extensively. Bir James Strackey, in his work on the "Finances of India," some years since, placed the area of cultivated land at 200,000,000 acres, of which 28,000.000 acres were cultivated by irrigation.
Of this total about 12,000,000 acres were served by water drawn from wells, and generally by man power, it boing found that the use of the mot or bullock well is too costly for that com-try of cheap human labor. The general verdict among engineers and practical administrative officers is that the land irrigated by well water is more economically served than that irrigated by water from canals. Canal water is, however, more fertilizing, having been exposed to the sun. The waste of water in canal use has been found to be so great in many portions of India that the ongineers have begun the work of lowering the canals, so as to compel the lift and distribution of water by mechanical means. This results in greater economy in its

THE WONDERFUL WELLS OF THE SAHARA. In the last Government report on the subjest the reciamation of the desert area of Algeria is cited as the most remarkable example of the marvels wrought by artesian



ARTESIAN WELL AT BATTLE MOUNTAIN.

water. One half the area of 329,000 square miles belongs to the Bahara or desert. The population in 1887 was 3,578,000. Cuitivation by the means of flowing wall waters has been fostered aedulously by the French Colonial Government for both political and economis reasons. Such wells as a means of reclamation began systematically to be bored in 1837, the French engineer, M. Gus, having demonstrated in 1856 that the desert was endowed with large supplies of underground water. The total number of wells that have been bored since that date in the departments of Algiers, Oran, and Constantine is



CANAL IN BARTON VINEYARD, PURSNO, CAL-

still an open question to what extent the steading well arstom will solve this problem. Wonderful things have been accomplished by means of those wells in hundreds of places. is fact, the most striking marvels of irrigation which the traveller sees on the great plains the best wought by the freeing of subter-

issen waters,
There is one other method by which the
materapean streams may be brought to the
mater, but it is available in very few places,
in interesting example of it is found at Garderflar, Kan, where the Great Eastern Irriin City, Kam., where the Great Eastern Irri-Mion Ditch Company has tapped the under-found stream by disging a trench with a My slight along the market and along a slight slope into the more steeply sloping Main. At a point one mile west of Hartland, as the Arkaneas, the company began to deepen the ditch so that while the bottom has a fall maintainterest to secure the ready flow of the water its death below the security. miliant to secure the ready flow of the water its death show the surface of the ground is made is increase as it extends westward. In the matress of one mile the depth has been so in-made that it is now ten feet below the surface. Into the ditalt thus formed, so as to its the saturated sand at ten feet below, a bedy of water is flowing it feet wide and it is the ditalt thus formed as the saturated sand at the feet wide and it is the deep. Some distance below the saturate as the saturate depth of inches. The water plane, which is found in fim. close sand fully asturated, begins to farm close sand fully saturated, begins to se or discharge water into the channel at the sail of exervation. The head of the ditch the appearance of a large sering, the

pir of which is coming out at avery point,
Great Pasiers Company intends to carry
hard of the ditch still further westward
imper, so as to secure the full advantage

stated at 13,135. These wells range from 75 to 600 feet in depth, and the low pressure common to the majority of them forces the water over the small bored casings to a distance of about two feet above the ground. The waters are then collected in small ditches, which convey them to the vineyards, date trees, and fields of durys, millet, wheat, etc., which comprise the chief products. In all about 12,000,000 acres have been reclaimed in this way. The flowernment bores are at least one-tenth of the whole number. Within thirty years the cases ireclaimed by wells) have increased in value fivefold.

THE GREAT AMERICAN DESERT DISAPPEABING,

The origin is our own country which must depend largely upon the underground supply for irrigation is simost entirely west of the 100th meridian. Half a century ago Gen. Fremont found the horder of the Great American Desert nearly 1,000 miles east of its present location and several hundred miles to the north. Chief Engineer Nettleton of the Irrigation Bureau at Washington says that his fory and observation teach that the necessity for irrigation is growing less, and that the line separating the humid from the semi-arid regions is moving westward. This movement is, however, growing slower and slower with each degree covered, and the point will somewhere be reached where it will stop. Hirse will be the buttle ground between the course courtry is not without a hope and a signer reactation of becoming eventually a region where agricultural and pastoral pursuit property combined can be carried on at a profit.

The region within which irrigation is necessary for successful agricultural development is, according to the States of Ranasa and Nebraka, both States of Dakota, the whole of the States of Indianas and Nebraka, both States of Dakota, the Whole of Texas, and about one-third of Orego, also the Texas and Arburdan. Within the largest of the mountains) of Yashington. This embraces the mountains) of Yashington. This embraces

shout one-third of our whole territorial surace, inclusive of Alaska. How much of the
atter named. Territory may be wholly or parially any or desert in oheracter cannot yet be
estimated. The east and west lines of this dry
regles. Leen, are, in the widest section, over
1,500 miles apart, and in its greatest length,
the northern and southern limits are about
1,500 miles apart. If the whole region were
compactly ayranged it would make a block
about 1,000 miles aquare.

A PRIMAREABLE CHANGE TARING PLACE IN
WESTERN CLIMATE.

Profs. Ramuel Aughev and U. I. Wilber of the University of Nebraska, after a lone investigation of the subject, declare that chemically the soil of the great plains is equal to any on the American complete broductiveness. They also declare that the reeds only water to insure complete broductiveness. They also declare that the present rate of increase in ramfall will in a comparatively short time fit the region for agriculture without the aid of infrantion. They cite various authorities and statisties to justify them is this conclusion, which is of the utmost importance, as affecting the slimate of the whole country.

Observation, experiment, and the highest scientific authority demonstrate that climates in the West are becoming moister, and that rainfall is increasing steadily. This increase must extend steadily until the plains east of Denver and Laramic received sufficient rainfall to produce farm products. For these reasons we are compelled to say that any evidence only for the present, and should not be used to cover these areas with the undeserved represend or these areas with the undeserved represend or these areas with the undeserved represend or the areas of desert lands.

THE VALUE OF THE ARTESIAN WELL SYSTEM. Authorities differ as to the aggregate value of the arisaian wall system for general irrigation. The irrigation Bureau as Washington.

humid ration. It differs from what I have called the arid region in that it senerally has a greater rainiall, distributed more evenly over the country, as it is not interrupted by great mountains where the precipitation is concentrated, having from 15 to 22 inches of rainfall in the average year; sometimes mee. Sometimes mee. There are many years when agriculture is prosperous without irrigation; there are others when it is its without an artificial supply of water. Gradually with the progress of agricultural development it is possible to cover the country with storage basins, or tanks as they are usually termed, in which water may be held to be used in seasons of drought. By this means the farmers may be able to tide over the dry years, and arming may be made prosperous and highly remunerative thereby from year to year. It is in this direction that the attention of the people of that region should be surned. Major Powell may be right or partly right in his conclusions, but recent experience in some portions of the West indicate that be has much underestimated the importance and value of the available water supply by means of artesian wells.



The principle of artesian well supply is simple. It is he same as that under which water is supplied in service pipes in cities. Water when confined tends to rise to the level of its source. The subterranean waters are confined between two impervious streat. Thus in the cut the artesian sand "bb" is confined

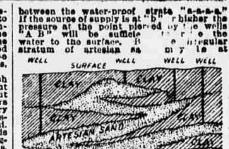


IN A VINRYARD IN ALAMEDA COUNTY, CAL.

of which Biebard J. Hinton is the head de-

of which Bichard J. Hinton is the head devotes its investigations almost egclusively to this branch of the subject, and its reports indicate the belief that the whole solution of the problem is to be found in this line. On the other hand Major Powell, the head of the United States Geological Survey, who has likewise made very extensive surveys and inquiries, came to these conclusions:

"Artesian reservoirs can never furnish waters for agriculture on a scale o, sufficient magnitude to be considered as an important source of supply. The amount of waters which porous rocks will supply is always very insignificant compared with the amount necessary for irrigating any great tract of land. More than half the agriculture of the world is dependent on irrigation. Of this, a very insignificant compared with the annount for the world is a frica, and America, and in some of the great islands, but altogether they furnish a very small amount of water for agriculture. If all the artesian wells used for irrigation in the world were assembled in bakota they would not irrigate a county of land. But there are other serious reasons why the attention of the people of the great plains should not be directed too confidently to this resource. It is the experience with artesian wells everywhere throughout the world that if



varying depth. in which case wells which are near together may have to be sunk some of them to twice or three times the depth of



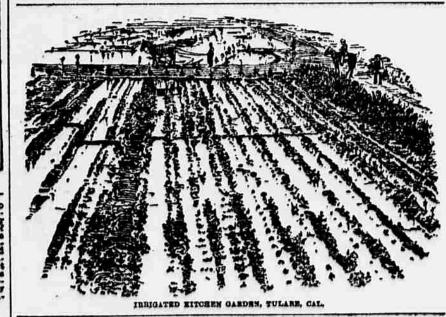
CAMAL IN SALT MINE VALLEY, ARIZONA, SHOWING IMPROVED AND UNIMPROVED LANDS.

too many are bored in any basin all are destroised thereby. In the northern Illinois district it was hoped that the great city of Chicago could be supplied with water for domestic purposes by artesian wells, but experimentation proved that, while a few good wells could be secured, a great number was impossible: that the supply of water was impossible: that the supply of water would be absolutely inadequate for the wants of the city; and so the authorities had to resort to the lake for their supply. Now, to irrigate the sife of the city of Chicago would take more water than to supply it for domestic purposes; so that the arresian wells of that district would be entirely inadequate to irrigate an area as large as the city, or perhaps one-fifth or even one-tenth of the area.

"Some years ago it was pointed out that the city of Denver and the region found about was the site of an artesian basin. The first well gite proved to be very valuable, and the desire to secure water for domestic purposes therefrom led to their multiplication. More than three hundred have now been bored, and gradually with the progress of the boring the cullapse of the wells has resulted, and now all the

others before water is reached. Artesian water is almost invariably soft and is often charged with mineral saits. In most places in the West such water is available for all uses. Prof. T. Sterry Hunt is authority for the statement that one square mile of sandstone 100 feet thick, of which the artesian stratum often consists. will contain water enough to flow one cubic foot per minute for thirteen years. The larger nortion of the upper Missouri basin between Fort Buford and Omaha is believed to be underlaid with sandstone of this porous and water conserving character. It is said to be doubtful if any geological substance is wholly impervious to the action of water. The lowest percentage given of water hald in rocks by complete saturation is found in the granites and is stated at .06 to .12. Coal shales at 2.85. carboniferous sandstone at 43.30 and chalk at 24.10.

MIGHTY TORRENTS FROM THE DAKOTA WELLS. The Dakotas furnish the greatest and most inexhaustible artesian wells in the country, if not in the world. A vast artesian basin is



wells have to be pumped: there is little or no flowing water from them. These instances might be multiplied all over the world, and the experience of mankind entirely testifies that it would be unwise to encourage the people of any district of country to depend upon artesian waters for irrigation on any large scale for farming. Waters for dome-tip purposes, for irrigating gardens, and for supplying stock ranches may thus be obtained in many regions, and the supply of water that can thus be furnished is of value; but when considered as a source for sarriguiture, for the cultivation of fields and large tracts of country, it will always be inadequate; and it is unwise to encourage any people to engage in agriculture on a large scale and derend on irrigation from artesian wells.

For the district of which I am now speaking extending from the British to the sextican line is a broad best across the plains on both will ultimately be compelled to depend upon tancher source of supply, and one so important that in comparison thesewith the artesian supply sinks into insignificance and seems hardly to be worthy the mention. I refer to the use of the acorany the mention. I refer to the use of the scorny waters. One-third of the agriculture carried on its irrigation through out the world is proseculed by the stocks and use of storm waters. One-third of the agriculture carried on its irrigation throughout the vannot be neglected. The region to which this is expecially applicable is the sub-

formed by the drainage of the Bocky Mountains to the northwest. The investigations of the Irrigation Bureau show that the drainage flow penetrates below the superincumbent stratum to the body of friable rock known as the Dakota sandstone, which appears to underlie the whole region. It is evident that the drill has newhere more than nemarrated a few inches of this water bearing and conserving stratum. The altitude, the general trend of the land, and the formation and character of the great hydrologient or river area which interesets it, give weight to the deductions that are made as to the extent and permanency of this remarkable stream opening. There are found within it about 150 high-pressure ariesian wells, including, with those in the Dakotas, the lew bored in the following would, whose supply is evidently from sources not identified with the sreater artesian basis. In northeast Dakota, in the hydrological basin of the field River, claimed by geologists to be the seat of an ancient lake, there can be found over a a thousand small flowing wells, whose waters are used largely for farming and homested purposes in sur-den and other small irrigations. No dimination of pressure is anywhere recorded. The course of their supply is from the upper beds of giacial drift.

and probability of sean; ing large artesian suplifes westward of both the James and Missouri rivers, and in a dagree that will prove to
be of great economic importance. The people
who have settled in the Dakotas belonged
originally, to States wherein the practice of
igrigation is unknown. Active settlement hegam in these two new common wealths during
years that were blossed with considerable
rainfall, and theraby the young communities
were greatly encouraged and rapidly became
prospecus. A few years, however, have
proven conclusively that the element of insecurity as to rainfall is really a permanent
one, it would be folly to deduce from such
a short period of years as that in which
observations have been taken any theoretical
dictum, but it is evident not simply from elimatic observations in the Dakotas, but from
those taken throughout the Great Plains region, and extending over a many longer paflor, that there is something like a periodicity
of abundance and drought, covering, so far as
can now be deduced from observation, cycles
of from seven to nine years in duration,
Bome of the great Dakota wells, vield enormous quantities of water. A well at Weonmous quantities of water. A well at Weonmout quantities of water. A well at Weonmout quantities of water. A well at Weonmout desired the boring of additional wells has
not diminished it sensibily.

TROUSANDS OF WELLS IF COLORADO.

THOURANDS OF WELLE IN COLORADO.

The latest reports of the Irrigatives Bureau from other parts of the West are sanguine of important results from the subterraneau surply of water. In Colorado there are four distinct sylvation basins resorted. That of Denver is at present the most thoroughly developed. Water is found at from 65 to 1,000 feet dees. The flows are from 100 to 809 gallions pay migute in rach well, and it is used mostly for domestic purposes. A decided success has resently been made in serving market gardens of from eight to fitness cores each. There are about 800 is this basin of which at jeast 250 are still flowing. The decrease of flow is due to want of control by the municipal or other authority in the matter of boring, and also from the want of regulation, such as necessity has imposed in San Bernardino, Cal., by which advantage is taken of the periodicity of the aupply. The Greeley basin is one of deep wells. The water is used exclusively for domestic purposes. There are twelve such to 1,300 (set. The water is used exclusively for domestic purposes. The rubble basin is one of the purpose of the first and therefore, and at present there are eight wells therein, west of Pueblo. At Florence and Canon City, along the drainage basin of the Upper Arkansa, several heavy flows of water have been struck in boring for oil wells. The supply is need for irrigating purposes, the flow of which it is estimated will serve 100 acres. The most remarkable basin found in Colorado is situated into ontain, and west of the line of this investing the past year over 2,000 flowing water have been sunk in the San Luis valley or basin, which contains floods oncure miles, and has an average altitude of about 7,000 feet. Burrounded by ranges of the highest mountains on the continent, whose sides inward to the basin are extuencely precipitous, a vast drainage basin of the lines of this investing the past year over 2,000 flowing and has an average altitude of about 7,000 feet. Burrounded by ranges of the flowing water is stru THOUSANDS OF WELLS IN COLORADO.

has been turned to the possibility of obtaining artesian water by well boring. There are now some sixty-seven wells in Newada. flowing from \$0,090 to 1,000,000 gallons every twenty-lour hours. The Board of Releasemation Commissioners in that State declare the possibility of reclaiming, by means of any subterranean waters as will frie through wells or can be utilized from application of applying the water positionary and after the ground has been introduced any subterranean waters as will frie through wells or can be utilized from application are semi-tropically in sacerted that artesian waters will be readily obtained and be extramely valuable for recipient and the maintain asswering the power when the mountain asswering the citing than at any other time.

Unuser deprivation of the semi-tropical of the semi-tropical products and fulls will be raised there is abundance.

Unuser deprivation and the semi-tropical products and fulls will be raised there is abundance.

Unuser deprivation and the semi-tropical products and fulls will be raised there is abundance.

Unuser deprivation after the strong the water of applying the water of semi-tropical products and fulls will be raised that are also deposited for semi-propical products and fulls will be raised there is abundance.

Unuser deprivation and the some of the water the surface for semi-tropical products and fulls will be raised there is abundance.

Unuser deprivation and the some of the water the surface for a lurgely increased area, the explanation being that wells may be found and that such supplies can be obtained after examination by competent geological and the serious department of the surface for a lurgely increased area, the explanation being that wells may be found and that such supplies can be obtained of its anish deep into the dry carta, of its anish deep into the dry carta, of its anish deep into the dry carta, of its anish deep into the



EFFECTS OF WATER ON DESET LAND IN TULARE COUNTY, CAL

engineers. More than one lost or sunken river, like the Sante Urus in southern Arizona, is known to so et. Thore are large stratches of country in which water lies so near to the surface as to greate what the Mexican people call clonegas. In the han signon valley, for oxample, a broad greasy tables and stretching for miles between two great ranges, water in large quantities can he found almost anywhere from eight to thirty feel below the surface. Crossing into seuthwestern New Mexico, and over its high bench land or meas, at Demiss, where two great continental railroads meet, of

raised and distributed to the surface by means of windmill pumps. In eastern New Mexico there is an extensive region of large springs, showing the existence of water under ground that comes by artesian force or otherwise to the surface.

force or otherwise to the surface.

In southern arizona there are areas of underground supply that can be descloped. The Santa Cruz River, for example, flows under ground to Maricopa, in the Gila valley. It runs into the Gila River near that point. The Santa Cruz River rises a few miles below the senthern line of the United States, in Moriec, it runs simpost directly north to Tuccon, Nine miles beyond Tuccon it is lest under ground, and then for some eighty-seven miles

SUNNY SLOPS WINERY, SAN GABRIEL VALLEY, CAL.

which a few years ago a great lawyer declared, during a land suit. that its "only proper inhabitants were horned toads and scorpions," there is now to be seen a large community with a prosperius town in its centre, surrounded with gardens and fields, the irrigation of which is supplied from wells bored to the depth of from 40 to 80 feet, the water being 100 gallons per minute. The deepest well, in the centre of the basin toward the east, has gone down nearly 1,000 feet. USE OF UNDERGROUND SUPPLIES IN TEXAS.

Use of undergound surplies in texas.

The report made by Field Agent F. E. Rossler in relation to the artesian waters and other subterranean surplies of Texas west of the inacty-seventh meridian is the most minute of all that has been presented. Nearly 700 flowing wells are reported upon. These wells flow from 1 to 1,000 gallons per minute, and vary in depth from 15 to 1,852 feet, and in cost from \$25 to \$7,200. The average flow is about 15 gallons per minute, and vary in the seven of the seven

INTERESTING MORMON IRRIGATION LAWS.

is called the Staked Plains.

INTERESTING MORMON IRRIGATION LAWS.

In Utah about 2,000 bored wells have been sunk into the higher water-bearing stratum of the Salt and Utah lakes region. These wells rise through small-bore pipes, from 1% to 3 inches in diameter, with a flow of from 1% to 3 inches in diameter, with a flow of from 1% to 3 inches in diameter, with a flow of from 1% to 3 inches in diameter, with a flow of from 1% to 3 inches in diameter, with a flow of from 1% to 3 inches above the casing. No records of any value have been kept as to the service their waters render. The Mormon laws for the competency of the service are comprehensive and interesting. They provide among other features:

The treatment of natural water supplies, under legislation, as public property, to be used for the common heast. The construction of all distributive agencies tartificial at the cost necessarily of those to be benefited. The incorporation of the expected beneficiaries by usighborhood companies, under general law, and the assessing of costs cooperatively, by means of share purchasing and holding, according to the number of agree to be served by the water so utilized. The distribution of water under stated regulations, which have the effect of law, under the supervision of an officer specially chosen for the purpose. The payment for this authorized use by means of stated rates, levied upon the volume of water used.

Small fargaers generally secure a water right for each acre, but others who hold, say, from 40 to 50 acres, cometimes only take water right as a tillage farm and the other as a grazing block, sliernstely. A water right means the privilege of taking as much water as the land renulared during the irrigating season, and the misintenance tax varies from 10 cents to 16 cents par acre per annum, according to "easiness" or otherwise of the channels. Subsidiary ditches, called laterals, are made by the farmers act later own cost, from alled each, and they may have water rights its and every morning he looks at his n

NEVADA'S VAST PLAINS.

In Neyada, with it-average altitude of 4.500 feet, and its mountain ranges rising from 5,000 to 11.000 feet above the level of the sea, the existence of large springs, many of them highly mineralized, is everywhere apparent. The stention of ranchmen and farmers in that State

*

became necessary.

THE CONCLUSIONS OF THE IRRIGATION BURBAU.

Supervising Engineer Nettleton of the Irrigation Bureau reaches the iofforwing conclusions as the result of investigations thus far made by the Government:

(1) The existence of a large artesian basin in the Dakotas which is indicated by the number of flowing wells acattered over an area of about 12,000 square miles.

(2) The presence of an abundant supply of water in a loose sand stratum of great thicked neas and subjected to great pressure, which is fully maintained after being pierced by numerous wells flowing their full capacity for years.

(3) The probability of an extension of this basin to westward or a considerable distance from the James liter valley developments and having similar characteristics.

(4) The probable existence of an artesian basin in T-kas similar to that in the Dakotaa and of unknown area, but lying at a greater depth from the sur-ace.

(5) The existence of several artesian basins in their parts of the country examined, which have similar flows, from which water is obtained in sufficient quantities for domestic use, and in some instances, for the irrigation of small areas.

(6) The existence of large supplies of subservational in sufficient quantities for domestic use, and or irrigation to prevent other in a difference of large supplies of subservational material parts of the majority of the people of the methods for utilising the whole territory examined.

(9) The large of a closer and more extended geniogical examination to designate as mean as possible, where it is probable that water may or may not be obtained.

(11) The necessity of investigating the subserving could be extent of country which can be reclaimed by them, and to report on methods for trilising the autorior.

The latest Government reports present the extent of country which can be reclaimed by them, and to report on methods for tringing such waters to the surface and the extent of country which can be reclaimed by them, and to report on methods for bringing

creased humidity of the soil may have on the atmospheric humidity is not yet known.

In some parts of California where the artesian supply was at first supposed to be inschaustlije the multiplying of the wells soon rendered all of them queeless. A strict system of local laws governing and limiting the time when the various wells might be drawn upon became necessary.

THE CONCLUSIONS OF THE IRRIGATION BURRAU.

The latest Government reports present the following summary by States of the area of land under cultivation by registion in the arid and semi-arid region. The figures are for 1890:



The San Francisco Chronicle some time ago prepared the following interesing table to show



IBBIGATING DITCH IN AN ORCHARD, INGLEWOOD, CAL.

it flows under ground, until it enters the Gila and helps to swell that river.

it flows under ground, until it enters the Gila and helps to swell that rivor.

California shows, perhaps, the most complete development of the artesian surely, as the does the most extensive canal and reservor system of irrigation. There are more than 3,000 artesian woils in the State, irrigating from one-quarter acre to 1,000 acres each. About 60,000 acres in all are served by them, in the upper part of Kern county, just south of Tulare Lake, there are about forty great wells within a radius of ten miles, none of which yields less than 1,000,000 gallons per day. The twelve largest, whose flow ranges from 1,200,000 to 2,6,0,000 gallons per day. The twelve largest whose flow ranges from 1,200,000 to 2,6,0,000 gallons which will serve at least 20,000 acres. The temperature of this water is almost uniform, being about 11°, both winter and summer. The average depth of the upper or northern wells about 50 feet ranging from 250 to 500 feet. It depth, the east running from \$500 to \$5,000, and averaging about \$1.400 cach. The first of these wells was borred about twelve years since. Theiruse has been largely contined to the unitivation of lating a dotter eastle feed. They are probably in the same region 500 for more bored wells, the water of which, derived from stratum near the surface, does not rise thereto, but is lifted above it by mechanical means, Ferhespathe most emarkable well from the stendpoint of economics one in the neighborhood of Deland, it has some one type the foot all strength and of considerable depth and width, which has the appearance of a small free.

In parts of the Sea Jeanin valley shallow wells have been known to fail after we can three shoes a processive years of light rainfall, and to chiral and of considerable depth and width, which has the appearance of a small free.

how wast is the importance of irrigation to the wollars of the world at large: 80, 100, 000 80, 100, 000 80, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, 101, 000 8, Country

Totals Transition 1,880,000 126,860,000 In Europe irrigation is practiced in Italy, France, Spain, England, Turkey, Portugal, and Greece. Attopether some 3,050,000 agree are upder irrigation. In Mexico and South America 2,500,000, Outside of the Unit-d States, therefore, there are 138,250,000 agrees cultivated by irrigation, end there is a population of between 700,000,000 and 800,000,000 resident in irrigating countries.

700,000,000 and 800,000,000 resident in irri-gating countries.

An i in summing it all up it may be saced:
Where on there be found a more striging demonstration of the fact that this old world ef-oursis still young, that its resources have not yet begun to be tested, and that the few seat-tered millions upon its surface are but a frac-tion of the population which might live in com-fort upon the fruits of its soil?

Hardly o biscone.

From Herrer's Asser.

Was your elopement a success!"

Hardly your wrong "

What your wrong "

For taker telestabled, as not by return to be foreigned.